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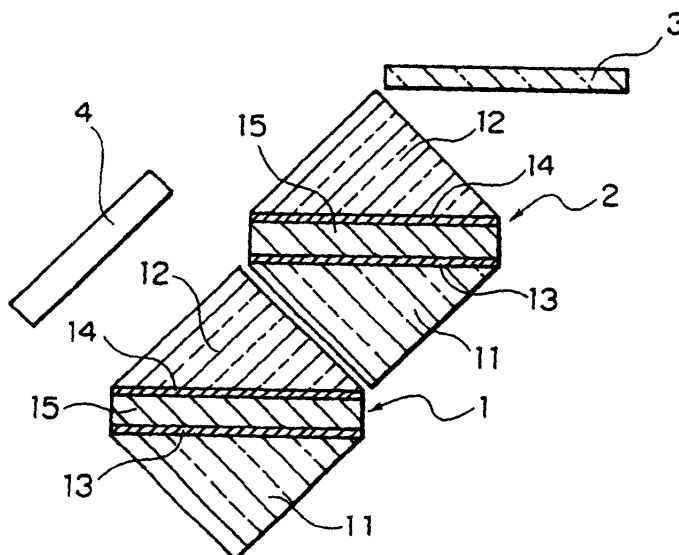
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(54) **Light modulator controlled by surface plasmon waves**

(57) A light modulator has two unit devices (1,2) each using surface plasmon waves generated at the interface between thin metal films (13,14) formed respectively on prisms (11,12) and an electro-optical material (15), and a mirror (3). Both the transmitted light due to absorption and re-radiation, and the reflected light arising from the unit devices (1,2) appear in the outgoing light, the incident light on the next unit device, or the incident light on the mirror (3). Consequently, all light

beams can be utilized as the final outgoing light beams with no loss of light. Further, the colour of light can be spatially divided, and still further, it can also be temporally divided by changing the wavelength by means of a voltage. As a result, the original light can be divided both temporally and spatially with almost no loss by combining two unit devices so configured as to re-radiate the absorbed light by the surface plasmon waves using surface plasmon and a mirror, and thus utilize both the reflected light and the transmitted light.

**FIG. 7A**



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## EUROPEAN SEARCH REPORT

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| DOCUMENTS CONSIDERED TO BE RELEVANT  |   |   |  |
|--|---|---|--|
| Category   | Citation of document with indication, where appropriate, of relevant passages   | Relevant to claim                                   | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
| A  | YU WANG: "Scrolling color projection display using surface plasmon tunable filters"<br>PROJECTION DISPLAYS IV, SAN JOSE, CA, USA, 27-29 JAN. 1998, vol. 3296, pages 149-153, XP002263459<br>Proceedings of the SPIE - The International Society for Optical Engineering, 1998, SPIE-Int. Soc. Opt. Eng, USA<br>ISSN: 0277-786X<br>* the whole document *                | 1-11  | G02F1/19<br>G02F1/13357                      |
| A  | YU WANG: "Surface plasmon tunable filters and flat panel display device"<br>FLAT PANEL DISPLAY TECHNOLOGY AND DISPLAY METROLOGY, SAN JOSE, CA, USA, 27-29 JAN. 1999, vol. 3636, pages 69-72, XP002263460<br>Proceedings of the SPIE - The International Society for Optical Engineering, 1999, SPIE-Int. Soc. Opt. Eng, USA<br>ISSN: 0277-786X<br>* page 70 - page 71 * | 1-4   | TECHNICAL FIELDS SEARCHED (Int.Cl.7)<br>G02F |
| A  | EP 0 395 986 A (BASF AG)<br>7 November 1990 (1990-11-07)<br>* column 1, line 32 - line 51 *   | 5   |  |
| A  | US 5 221 982 A (FARIS SADEG M)<br>22 June 1993 (1993-06-22)<br>* abstract; figure 5 *   | 1-7,9,10  |  |
| The present search report has been drawn up for all claims   |   |   |  |
| Place of search<br>MUNICH  |   | Date of completion of the search<br>1 December 2003 | Examiner<br>Hauser, M                        |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |   |   |  |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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The members are as contained in the European Patent Office EDP file on  
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01-12-2003

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---------------------|----------------------------|---------------------|
| EP 0395986 A                              | 07-11-1990          | DE 3914377 A1              | 08-11-1990          |
|   |                     | AU 5391090 A               | 01-11-1990          |
|   |                     | CA 2015666 A1              | 29-10-1990          |
|   |                     | EP 0395986 A2              | 07-11-1990          |
|   |                     | JP 2302707 A               | 14-12-1990          |
| -----                                     |                     |                            |                     |
| US 5221982 A                              | 22-06-1993          | NONE                       |                     |
| -----                                     |                     |                            |                     |